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A REVISION OF THE GENUS BLATTELLA (BLATTARIA: BLATTELLIDAE) OF JAPAN, I. TERMINOLOGY OF THE MALE GENITALIA AND DESCRIPTION OF A NEW SPECIES FROM OKINAWA ISLAND*

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Abstract

Male genitalic structure of *Blattella* is discussed and illustrated. Some new terms for genitalic sclerites are proposed. Based mainly on the male and female genitalic characteristics, a new species, *Blattella asahinai*, is described from Okinawa Island.

The genus *Blattella* Caudell, which includes the German cockroach *B. germanica*, is one of the most important genera in the Blattaria. *B. germanica* has been exclusively used for the material for various studies in entomology. In the course of my study on the morphology of the male genitalia of this genus, I was able to detect some interesting characters in *B. germanica* and its allied species, especially in two exotic forms such as *B. sauteri* from Thailand and *B. karnyi* from Taiwan. Therefore, I intend to clarify the general structure of the male genitalia of *Blattella* in this paper.

The classification of Japanese *Blattella* has been advanced by S. Asahina (1963, 1964). Three species has been recognized from Japan. I was able to find, however, the fourth species from Okinawa Island. It remarkably differs from the other Japanese species in the male and female genitalia. According to Dr. Asahina's suggestion, it is described as a new species in this paper.

Before going further, I wish to express my sincere thanks to Professor Yoshihiro Hirashima and Associate Professor Katsura Morimoto of Kyushu University for their invaluable advice and encouragements. My thanks are also due to Dr. Syoziro Asahina of Tokyo (formerly the Director of the Department of Medical Entomology, National Institute of Health, Tokyo) not only for his kind permission to examine the material preserved in his institution but also for his constant guidance in the course of the present work. I am grateful to Professor Seiji Azuma and Mrs. Masako Honda-Yafuso of the

* Contribution from the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka (Ser. 3, No. 97).

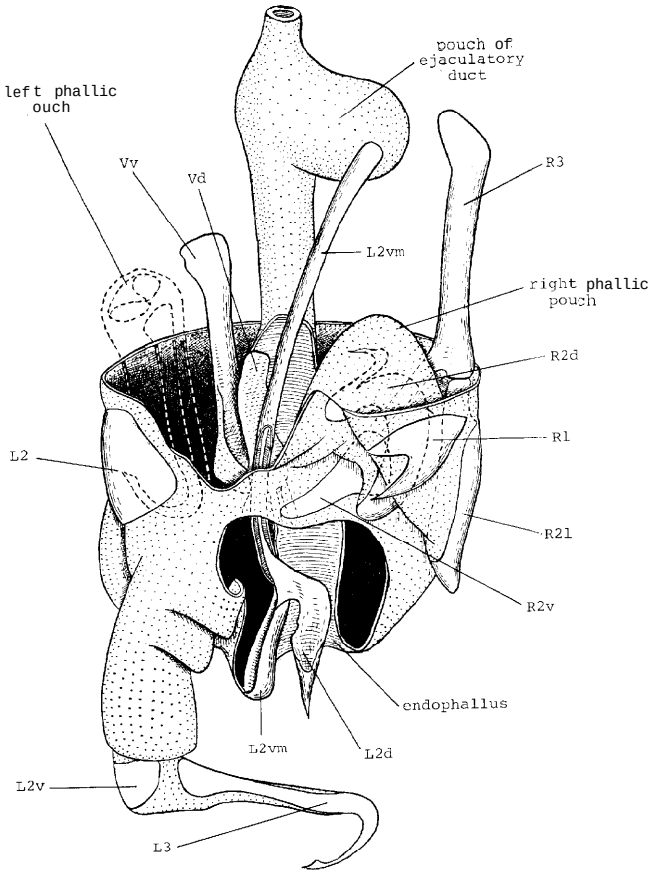

Fig. 1. Diagram showing the generalized male genital structure of the genus *Blattella*, dorsal aspect. For explanation see the text.

University of the Ryukyus for their kind assistance during my field works in the Ryukyus. I am also greatly indebted to Dr. Osamu Tadauchi of Kyushu University and Mr. Hiroshi Makihara (now Forestry & Forest Products Research Institute, Tsukuba Norin Kenkyu Danchi, Ibaraki) for their kind help in the course of my present study.

Terminology of the Blattellan male genitalia

The terminology of the Blattellan male genitalia is given below based on my comparative studies on the structure. I have largely adopted the system proposed by McKittrick (1964). The diagram of the generalized Blattellan male genitalia is shown in Fig. 1.

Paraprocts: a pair of large hooks concealed beneath the margin of the tergite X.

R1: a spine- or thorn-shaped sclerite situated dorso-inwardly on the frontal base of R2l. R1 is well developed in *B. sauteri,* but in the other congeneric species, it is usually reduced into a thin flattened sclerite. It should be noted that this sclerite was neglected by McKittrick (1964).

R2d (a new term) : a dorsal division of R2; a thick rounded crescentic free sclerite which is situated whithin the inner wall of the right phallic pouch. (=S cl erotic fold of wall of right phallic pouch, Snodgrass, 1937).

R2l (a new term) : a lateral division of R2; a hollow, usually elongate lobe being situated laterally on the genital pouch and articulated anteriorly with the right margin of R3. (=Right phallomere, Snodgrass, 1937).

R2v (a new term) : a ventral division of R2; a broad and flat sclerite, situated ventrally and completely detached from R2d and always articulated with the frontal margin of R3.

R3: a long and slender sclerite, projecting anteriorly within the genital pouch and forked in the wall of the right phallic pouch (=Apodeme of right phallomere, Snodgrass, 1937).

L3: an enlarged sclerotized hook usually situated in the left phallic pouch. (= Left phallomere, Snodgrass, 1937).

L2: a thin but moderately broadened sclerite which is found on the left of the latero-frontal region of the genital pouch.

L2d: a usually solid sclerotized process on the apex of penis (sensu Snodgrass, 1937) fused to the posterior part of L2vm. Basal portion **of** L2d is elongated and inserted deeply into L2vm; in *B. karnyi* apical portion of L2d is represented by a moderately broadened conical hollow sclerite. (= Virga, Walker, 1922 ; Snodgrass, 1937).

L2v: a small and flat sclerite situated basad of L3.

L2vm: an internal process or apodeme projecting from the apex of penis, arched dorsally in lateral view. In *B. karnyi,* the posterior portion of L2vm is broadened and strongly produced posteriorly like L2d. (=Endophallic apodeme, Snodgrass, 1937).

Vd (a new term) : a well sclerotized flattened plate on the ventral wall of endophallic sac, being right opposite to Vv. Vd is assumed to be homologous with the endophallic sclerite (sensu Snodgrass, 1937) found in the Blattidae. This is, so far, found only in *B. karnyi.*

Vv (a new term) : a strongly sclerotized apodeme on the ventral wall of endophallic sac producing into the body cavity. This structure has never been observed in the Blattellidae. In *B. karnyi,* however, this is conspicuous. In the other species of the Blattellidae, so far as I know, this sclerite is much reduced and divided into very minute 3 sclerites which are, according to their relative positions, designated as Vvl (left division), Vvm (median division) and Vvr (right division), respectively.

KEY TO THE SPECIES OF *Blattella* OCCURRING IN JAPAN

1. Male: — length less than 12.4 mm; tergite VIII with a membraneous median lobe between openings of excavations; latero-apical angles of tergite IX strongly produced ; supra-anal plate short, apical margin apical to cerci shorter than broad ; styli distant; in genitalia, shaft of L3 with inner apical margin fringed with minute sclerotic teeth; ***female: -length*** less than 13.0 mm; genitalia with anterior expansion of right paratergite absent, right and left basivalvula very small or indefinite, without spines ..... **lituricollis** (Walker)

– ***Male: -length*** more than 11.5 mm; a membraneous median lobe absent in tergite VIII; latero-apical angles of tergite IX less produced ; supra-anal plate elongate, apical margin apical to cerci longer than broad, styli more approaching each other; in genitalia, shaft of L3 with inner margin smooth apically; ***female:*** — length more than 13.0 mm ; genitalia with anterior expansion of right paratergite present; right and left basivalvula enlarged and definite with spines 2

2. ***Male and female:*** — pronotal stripes convex inwardly at posterior ends; distance between stripes as wide as stripes; ***male:*** — apical pair of transverse excavations of tergite VII very shallowly concaved; tergite VIII with a convex medio-longitudinal line from middle of twin excavations to apical margin of tergite; left stylus armed with 3 thorns in a row; genitalia with R2l less than 3/4 times as long as R3, L2vm almost straight and stout; ***female: -blotches*** of supra-anal plate sharply defined ..... **nipponica** Asahina

– ***Male and female*** : — pronotal stripes not enlarged at posterior ends,'more separated each other than their widths; male: — apical pair of transverse excavations of tergite VII more deeply concaved; tergite VIII with a medio-longitudinal sulcus from middle of twin excavations to apical margin of tergite ; left stylus armed dorsally with sparse thorns; genitalia with R2l more than 3/4 times as long as R3, L2vm strongly decurved ; ***female: -blotches*** of supra-anal plate more or less indefinite 3

3. ***Male and female:*** — pronotal stripes simple, slightly more broadly separated by their widths each other; ***male:*** — interocular distance scarcely 3/4 times as long as distance between antenna1 sockets; lateral submarginal area of tergite VII immaculate ; apical margin of tergite VIII shallowly notched in the middle ; left stylus armed with 5 to 6 thorns; genitalia with R21 less than 4/5 times as long as R3, recurved portion of L3 elongate; ***female:*** — interocular distance more than 4/5 times as wide as distance between antenna1 sockets; apical margin of subgenital plate subsinuous distally ..... **germanica** (L.)

– ***Male and female*** : — pronotal stripes paler, irregularly shaped and rather irregularly separated each other; ***male:*** — interocular distance decidedly narrower, l/Z to 3/5 the distance between antenna1 sockets; lateral submarginal area of tergite VII weakly marked basally with brownish blotches; apical margin of tergite VIII more deeply notched in the middle; left stylus armed with 2 to 3 thorns ; genitalia with R2l nearly as large as R3, recurved portion of L3 shortened; ***female:*** — interocular distance less than 4/5 times as wide as distance between antenna1 sockets; apical margin of subgenital plate without sinuation distally ..... **asahinai** sp. nov.

Blattella asahinai sp. nov.

Male

Structure: Eyes fairly projecting, more projecting than in *germanica*; interocular space narrow, 1/2 to 3/5 as broad as distance between antenna1 sockets (in *germanica,* 3/4); head below eyes moderately elongate, fairly converging below. Pronotum (Fig. 2, A) very feebly convex, lateral portions moderately decurved, basal margin weakly produced posteriorly in the middle and very slightly emarginate sublaterally. Tegmina elongate, venation as in *germanica.* Wings broad, with no reduction. Legs: fore femora with ventro-anterior margins armed as in Type A, ventro-posterior margins usually with 4 stout, widely spaced spines (including single distal spine) ; other femora with ventro-anterior margins well armed with a few, elongate, moderately stout spines, numbering usually 6 to 7 in middle legs and 5 in hind ones; tarsal segments elongate, with 1st segment decidedly longer than following segments combined. Abdomen with tergites I to VI unspecialized. Tergite VII (Fig. 2, B) with latero-apical portions more emarginate, nearly --shaped, with two pairs of deep, rounded, transverse excavations which are rather close to the median line of tergite; these excavations also present in *germanica,* but different in shape, as stated below; narrow, well convex, transverse

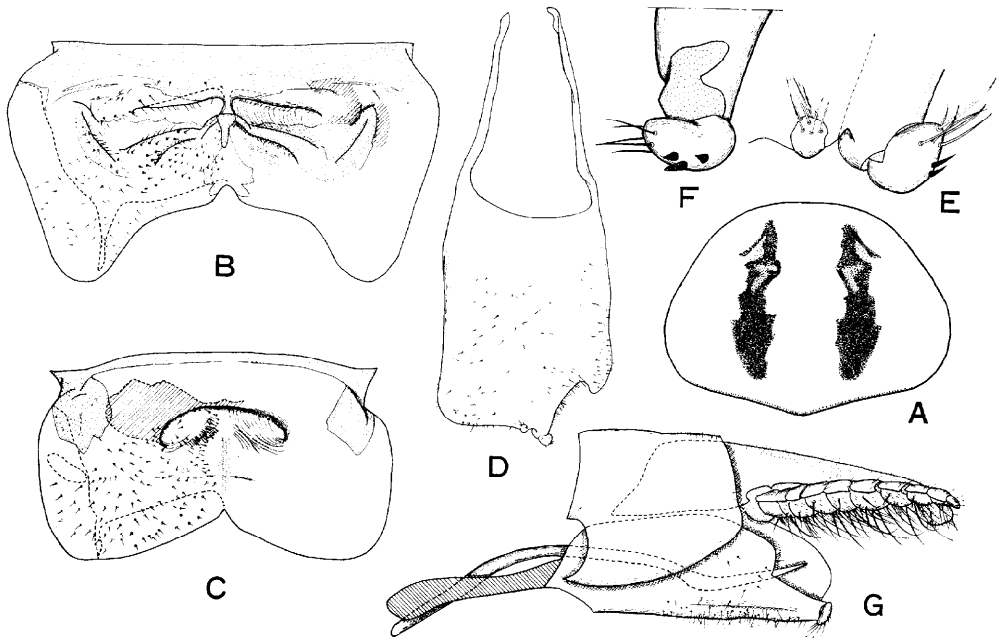

Fig. 2. *Blattella asahinai* sp. nov., male. A. Pronotum, dorsal aspect; B. Tergite VII, dorsal aspect; C. Tergite VIII, dorsal aspect; D. Subgenital plate, ventral aspect; E. Styli, ventral aspect; F. Left stylus, lateral aspect; G. Male terminalia, lateral aspect.

elevations between these excavations more broadened and heightened laterally; apical pair of transverse excavations rather shallowly concaved basally (in *germanica* they are deeply concaved with sharply defined apical margins), not sharply defined apically with sparse minute hairs; apical pair of excavations less transverse than the basal one; medio-apical area of tergite subsclerotized. Tergite VIII (Fig. 2, C) more transverse than in *germanica,* nearly bilobate with apical margin deeply incised in the middle, latero-apical portions more rounded and broadened than in *germanica,* rather strongly produced laterally, surface moderately convex (while in *germanica,* latero-apical corners obtusely angulate and weakly produced) ; medio-subbasal area with a pair of small but very deep excavations directed latero-basally below surface of tergite, bottom of excavations reaching almost basal margin of tergite; openings of these excavations with basal margin transverse and very distinct, not interrupted (Fig. 2, C), apical margin obscure, broadly interrupted in the middle (in *germanica,* openings of these excavations clearly separated as shown in Fig. 3, B) and armed with short hairs directed latero-basally ; a median longitudinal sulcus distinct ***on*** apical half of tergite. Tergite IX with latero-apical angles weakly produced ; apical margin weakly concaved. Supra-anal plate strongly produced apically, apical portion apical to cerci much longer

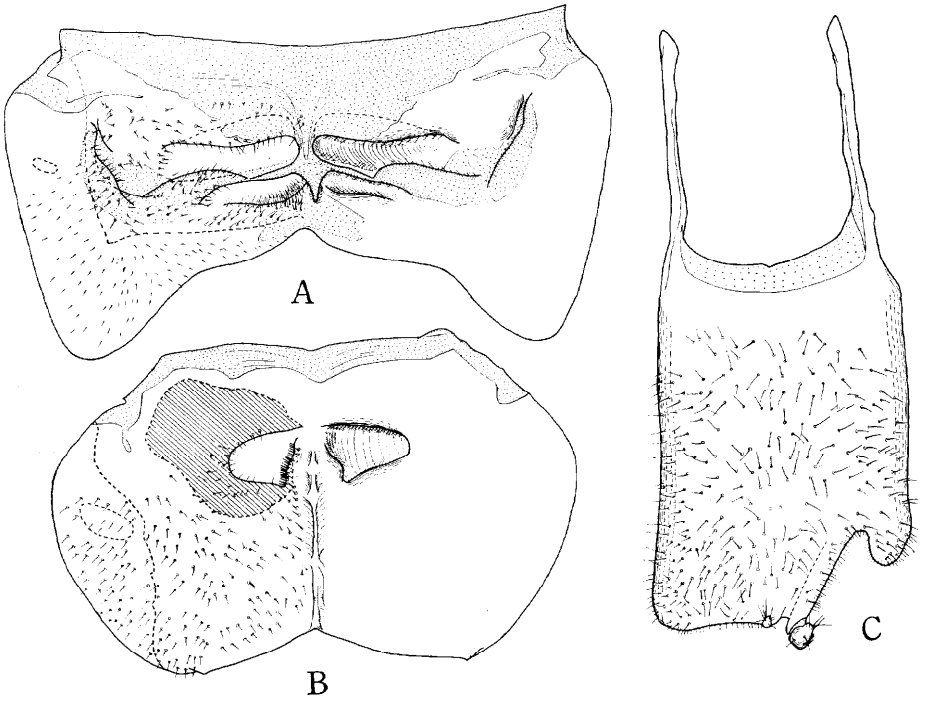

Fig. 3. *Blattella germanica* (L.), male. A. Tergite VII, dorsal aspect; B. Tergite VIII, dorsal aspect; C. Subgenital plate, ventral aspect.

than broad; cerci elongate, exceeding tip of supra-anal plate by 1/4 of their length (1/3 in *germanica*). Subgenital plate (Fig. 2, D) relatively short, broad, strongly asymmetrical ; apical emargination on left side less acute than in *germanica*; left apical stylus rounded and decurved (Fig. 2, F), dorsal surface of which is armed with coarse microscopic spines, 2 to 3 in number (5 to 6 in *germanica*); right stylus very minute, very close to the left one ; right apical portion of the plate evenly rounded, less projecting than in *germanica*.

Male genitalia (Fig. 4) : L3 (Fig. 5, A) simple, elongate, slender and flattened, but much shorter than that of *germanica*, and recurving evenly anteriorly ; warped portion moderately elongate, stout, short, not strongly recurved (in *germanica*, L3 recurving more sharply near its apical portion; warped portion more elongate and slender). L2vm (Fig. 5, B) moderately stout, elongate, aciculate, well curved. L2d (Fig. 5, B) elongate, stout, solid, aciculate, distal portion pointed, nearly straight, slightly curved basally. L2 (Fig. 5, C) simple. L2v (Fig. 5, A) present. Vd absent. Vv much reduced as in *germanica*. R3 (Fig. 5, Da, b) moderately large, slender, more than 1/2 as long as L2vm (in *germanica*, about half as long as L2vm); basal trunk straight, much broader at base; branch of R3 connected with R2v long and straight, slenderer than that of *germanica*; branch of R3 connected with R21 broad, short, with abrupt apex. R2l (Fig. 5, Da, b) much elongate, nearly as long as R3 (in *germanica*, about or little more than 3/4 times as long as R3; in dorsal view, right outer surface of R2l heavily sclerotized; left inner surface soft except for

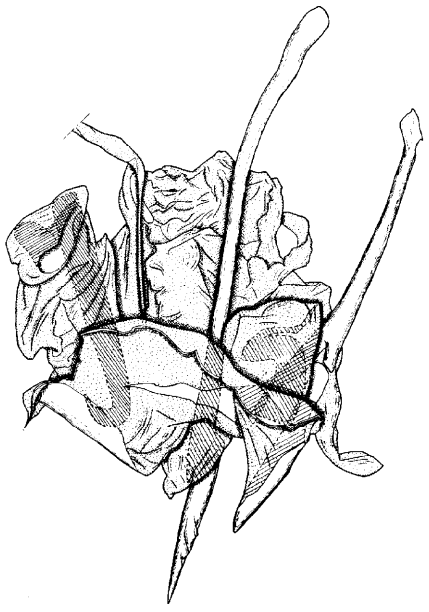

Fig. 4. *Blattella asahinai sp. nov.* Male genitalia, dorsal aspect.

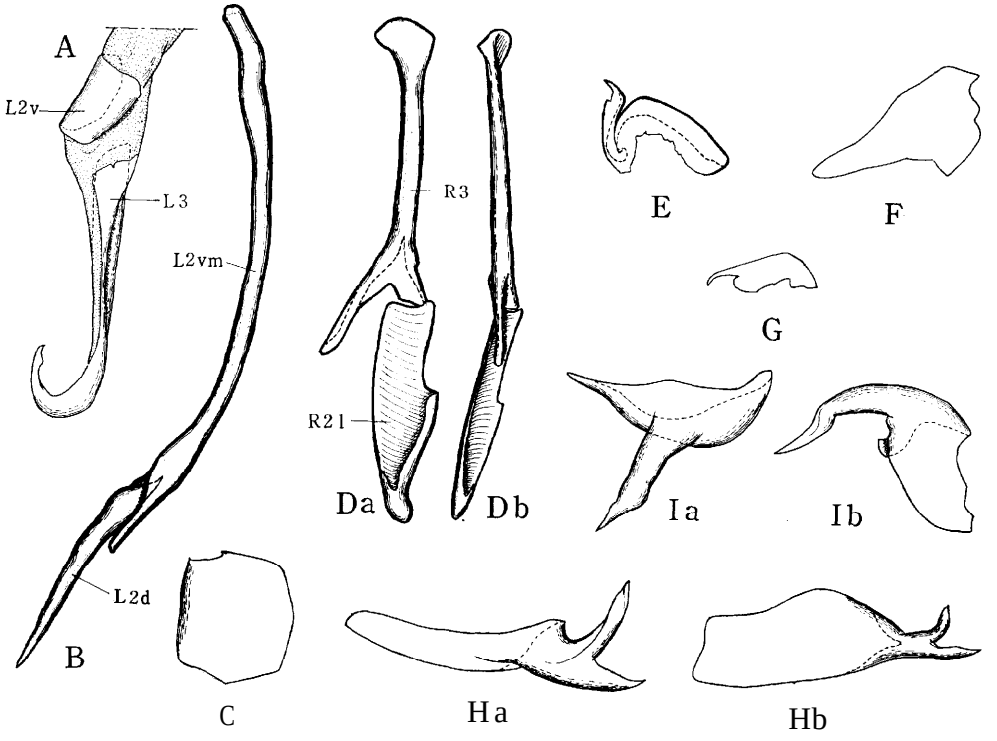

Fig. 5. Sclerites of male genitalia of *Blattella asahinai* sp. nov. A. L2v and L3, inner aspect; B. L2vm and L2d, inner aspect; C. L2, outer aspect; D. R3 and R2l, (a) dorsal aspect and (b) inner aspect; E. R2d, dorsal aspect; F. R2v, dorsal aspect; G. R1, dorsal aspect; H. Left paraproct, (a) ventral aspect and (b) caudal aspect; I. Right paraproct, (a) ventral aspect and (b) caudal aspect.

narrow sclerotized apex and right margin ; left margin of this sclerotized section very slightly convex outwardly (while in *germanica,* the corresponding margin sinuate). R2d (Fig. 5, E) smaller than that of *germanica,* with apical margin shallowly and narrowly emarginate (in *germanica,* apical margin of R2d deeply and broadly emarginate). R2v (Fig. 5, F) simple. R1 (Fig. 5, G) reduced, simple. Right paraproct (Fig. 5, Ha, b) transversely broadened, armed with aciculate, moderately stout, elongate, bifurcate hooks of subequal length (in *germanica,* ventral hook shorter than dorsal one) ; left paraproct (Fig. 5, Ia, b) with an elongate, stout and aciculate single hook which is unevenly recurved inward.

Coloration: Head, from interocular space to interocellar space, heavily washed with mars brown; frons buffy, usually immaculate, but rarely suffused between antenna1 sockets with a faint, T-shaped blotch of ochraceous-buffy tinge; maxillary palpi buffy, with last segments brownish at apices, often concolorous with preceding segments. Pronotal disk (Fig. 2, A) ochraceous buff,

with paired, somewhat indefinite, mars brown stripes, each normally broken anteriorly by a small, inwardly directed, V-shaped spot of ground color; these stripes reaching neither anterior nor posterior pronotal margins and leaving an interval of ground color mesially, the interval at posterior point 1.5 times and at median point twice as broad as greatest width of stripe; sides of disk pellucid with light yellowish tinge. Tegmina immaculate, ochraceous ; right tegmen with apical half of discoidal sector more decided with deep brown. Tergite VII (Fig. 2, B) with paired, short, longitudinal brownish markings on anterior half of latero-distal portions of longitudinal protuberances (these markings absent in *germanica*). Tergite IX suffused proximo-laterally with a pair of brown blotches; supra-anal plate also with a pair of irregular blotches. Abdominal sternites immaculate.

Female

Agrees with the male except for the following characters:

Structures : Head slightly more elongate ; interocular space decidedly wider, about 4/5 times as broad as distance between antenna1 sockets (more than 4/5 in *germanica).* Abdominal tergites unspecialized ; supra-anal plate transverse, triangularly and moderately strongly produced, apex rounded, with or without a very weak emargination, lateral margins moderately broadly concaved. Subgenital plate large, not produced, surface very weakly flattened

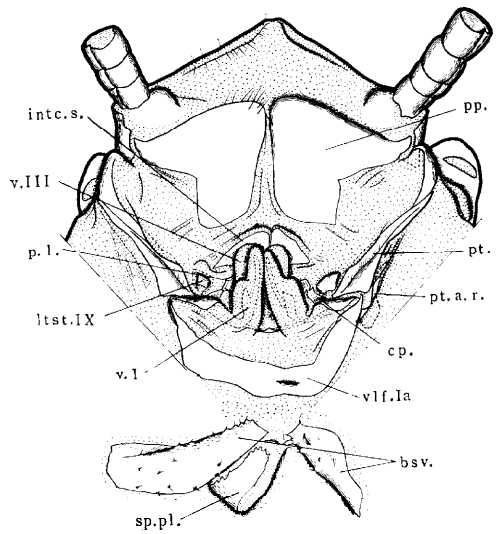

Fig. 6. Female genitalia of *Blattella asahinai* sp. nov., posterior aspect. pp., paraprocts; *pt.*, paratergite; *intc.* s., intercalary sclerite; *p.l.*, posterior lobe of valvifer II; *v.III*, third valve ; *v.I*, first valve ; *ltst. IX*, laterosternite IX ; *cp.*, crosspiece ; *pt.a.r.*, anterior expansion of right paratergite VIII; *vlf.Ia*, first valvifer arm; *bsv.*, basivalvula ; *sp.pl.*, spermathecal plate.

mesio-apically; apical margin nearly straight, not subsinuous distally (in *germanica,* apical margin weakly convex, subsinuous distally).

Female genitalia (Fig. 6) : Paraprocts longitudinally moderately shortened ; acute-angular mesio-apical margins with a group of elongate hairs directed inward-apically ; lateral portions very strongly produced distally, tapering to apical process which is evenly and weakly curved apically and strongly produced laterally than apically ; basal portions of paraprocts moderately short and broad. Intercalary sclerites, basal to paraprocts, moderately enlarged. Laterosternite IX enlarged, strongly sclerotized, and sharply defined. First valvifer arm distinctly asymmetrical, with mesial portion moderately straight and dilated; left arm shorter than right one. Anterior expansion of right paratergite present. Left basivalvula much enlarged, transversely elongated and broadened, apical margin with a few widely spaced spines; right basivalvula narrower, transversely shortened, apical margin armed with a few spines. Left spermathecal plate well sclerotized, transversely shortened, aciculate ; right one transparent, weakly sclerotized.

Coloration: Supra-anal plate marked basally with a pair of, proximo-lateral, vague brown markings which are almost completely interrupted mesially but fairly approaching each other, broader distally and inclining proximo-apically; apical portion of supra-anal plate almost transparent (in *germanica*, supra-anal plate without a pair of markings and suffused basally with broad brown band).

Measurements (in mm.) : Total length (including folded tegmina), male 11.5–13.6, female 13.8-14.8 ; length of pronotum, male 2.2-2.6, female 2.3-2.8; width of pronotum, male 3.0-3.5, female 3.5-3.7; length of tegmen, male 9.6-11.2, female 10.6-12.8; width of tegmen, male 2.7-3.2, female 2.9-3.7; length of abdomen, by the alcoholic specimens, male 8.2, female 6.0-6.4.

TYPE MATERIAL: Holotype male (Type No. 2326, Kyushu Univ.), Shuri, Okinawa I., Japan, 18. xii. 1979 (T. Mizukubo). Paratypes : 2 males, 1 female, same locality as holotype; 3 males, 1 female, Shuri, Okinawa I., 19. x. 1977 (T. Mizukubo) ; 2 males, Oku, Okinawa I., 17. v. 1978 (H. Makihara) ;1 male, 2 females, Yona, Okinawa I., 19. v. 1978 (H. Makihara) ; 1 male, Do., 14. v. 1978 (H. Makihara) ; 2 females, Do., 12. v. 1977 (S. Asahina) ; 1 female, Do., 11. v. 1977 (S. Asahina).

DISTRIBUTION : Okinawa Island, Japan.

REMARKS: The male of the present new species may be readily distinguished from that of the other congeneric Japanese species by having the interocular space decidedly narrower, 3/5 to 1/2 the width between antennal sockets. In addition the deeply emarginate apical margin of the abdominal tergite VIII and left stylus, which is armed dorsally with 2 to 3 spines, would be useful to distinguish B. *asahinai* from other three species.

The female resembles that of B. *lituricollis.* It is, however, distinguished from the latter by the subsinuous latero-apical margins of the subgenital

plate and by the blotches of supra-anal plate more approaching each other.

In October 1977, I collected some nymphs of this species on a footpath in a sugar cane field of the Agricultural Experimental Station of Okinawa Prefecture, Shuri, Okinawa. Like ***B. lituricollis***, this species is usually found among dead leaves and litter on the ground. Specimens were taken occasionally by sweeping over the tree-blossoms in the northern area of Okinawa Island (Makihara, pers. comm.).

The new species is named in honor of Dr. Syoziro Asahina of Tokyo in commemoration of his contribution to basic as well as medical fields of entomology.

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